

RB 500
Series

instruction manual

NORTH ATLANTIC
industries, inc.

Model ~~RB~~ RB-500 Series
(RB-503T & RB-504T)

ratio boxes ▶





Ratio Box

RB-500 Series -S 858

MODELS

RB-503T, RB-504T

**ALL CIRCUITS CONTAINED HEREIN
HAVE PATENTS APPLIED FOR:**

North Atlantic Industries, Inc.

Plainview

New York

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RB-503T and RB-504T

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INSTRUMENTATION BULLETIN



NORTH ATLANTIC
industries, inc.

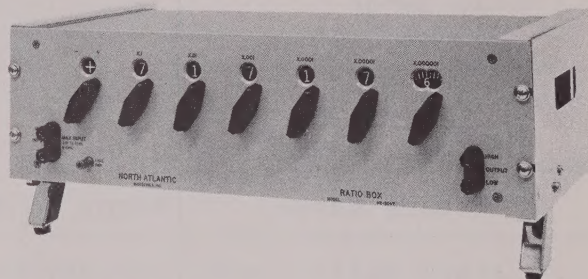
INVERTING AC RATIO BOXES

MODELS RB-503T & RB-504T

bulletin
RB-503T/504T

FEATURES/

- * Ratios from +1.111110 to -1.111110
- * Isolated Input & Output
- * High Accuracy at Low Cost
- * In-line Window Readout
- * Heavy-duty, long-life Switches
- * No Switching Transients



DESCRIPTION/

The Models RB-503T and RB-504T represent a departure from standard ratio box technique by providing a complete range from -1.111110 to +1.111110. This is accomplished by including a Model T-120 Inverting Transformer which can be switched in or out as desired. Both models feature six-digit readout, utilizing five switched decades and a single-turn potentiometer with excellent readability on in-line windowed dials. Heavy-duty rotary switches assure high reliability and long operating life. Transformers meet requirements of MIL-T-27A. Fold-away legs facilitate use on the bench, and easily-removed end plates allow quick conversion for rack mounting.

APPLICATIONS/

Applications of the RB-503T and RB-504T Ratio Boxes include precision calibration of resolvers and synchros where minimum loading, high accuracy and low phase shift are essential, and eliminating the need for rearranging the test setup or providing additional inversion switching within the test set. In these and other applications, use of the ratio boxes in conjunction with North Atlantic's Phase Angle Voltmeter* permits rapid, direct reading of nulls, phase shift angle and quadrature voltage.

Models RB-503T and RB-504T Inverting AC Ratio Boxes are two of North Atlantic's complete line of AC instruments for every measurement and test requirement. Other instruments for AC measurements and precision ratiometry include Series 200 and 300 Phase Angle Voltmeters*, Series 400 Phase Sensitive AC to DC Converters, and Series 500 Complex Voltage Ratiometers and Ratio Boxes.

NORTH ATLANTIC INDUSTRIES, INC.

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INSTRUMENTATION AND CONTROL SYSTEMS



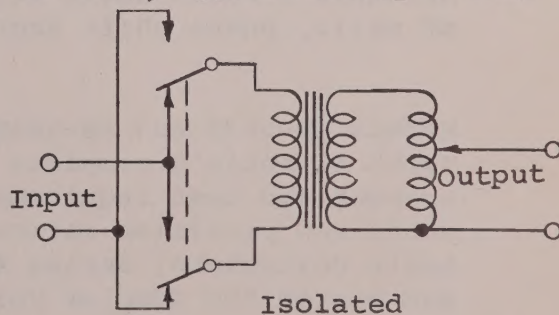
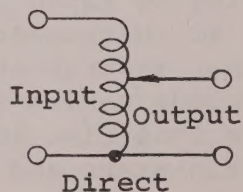
SPECIFICATIONS/ (Preliminary - Subject to change without notice)

	RB-503T		RB-504T	
	Isolated	Direct	Isolated	Direct
Ratio Range	± 1.111110	0.000000 to ± 1.111110	± 1.111110	-0.111110 to ± 1.111110
Accuracy @ 400~ (Terminal Linearity)	10ppm	10ppm	3.0ppm	1.0ppm
Frequency Range	50cps to 10kc	50cps to 10kc	50cps to 3kc	50cps to 3kc
Voltage Rating (f in cps)	.35f to 350v Max.	.5f to 350v Max.	.35f to 350v Max.	.75f to 350v Max.
Input Impedance at 400~	$> 10K$	$> 50K$	$> 10K$	$> 200K$
Nominal Output Resistance (Max.*)	5.2 ohms	3.5 ohms	10 ohms	8.5 ohms
Resolution	5 Decades + Potentiometer (0.3ppm)			
Phase Shift	less than 1 min.			
Switches	heavy duty			
Size	5 1/4" Standard 19" Panel (behind panel) 5"H x 17 1/4"W x 9"D			
Weight	34 lbs.		36 lbs.	

*Varies with ratio setting (peaks at ratio of .555, approximately 0 ohms at ratios of .0 and 1.0)

Accuracy traceable to National Bureau of Standards.

Circuit schematic:



TECHNICAL REPRESENTATIVE /



SUPPLEMENT SHEET FOR THE RB503T

TRIMMED AT 3.2KC

This unit has been trimmed for optimum operation at 3.2KC in the inverted, isolated modes.

For trimming other frequency bands, instructions are contained herein.

It is noted that the direct mode, not using the input transformer, is not affected by these trims.

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SPECIFICATIONS/ (Preliminary - Subject to change without notice)

	RB-503T		RB-504T	
	Isolated	Direct	Isolated	Direct
Ratio Range	±1.111110	0.000000 to +1.111110	±1.111110	0.000000 to +1.111110
Accuracy @ 400~ (Terminal Linearity)	10ppm	10ppm	3.0ppm	1.0ppm
Frequency Range	50cps to 3KC	50cps to 5KC	50cps to 3KC	50cps to 3KC
Voltage Rating (f in cps)	.35f to 350V Max.	.5f to 350V Max.	.35f to 350V Max.	.7f to 350V Max.
Input Impedance at 400~	> 10K	300K	> 10K	> 200K
Nominal Output Resistance (Max*)	5.2 ohms	2.75 ohms	10 ohms	8.5 ohms
Resolution. Phase Shift	5 Decades + Potentiometer (0.3 ppm) Less than 1 minute			
Switches	Heavy Duty			
Size	5 1/4" Standard 19" Panel (Behind panel) 5"H x 17 1/4" W x 9" D			
Weight	40 lbs.		42 lbs.	



GENERAL DESCRIPTION:

The RB-503T and RB-504T incorporate the features of the high accuracy of the standard ratio box RB-500 series and the North Atlantic Model T-120 Precision Inversion Transformer. This combination provides a complete range of ratios from -1.111110 to +1.111110, as well as signal isolation. The RB-503T and RB-504T can be converted to a standard ratio box merely by switching to the direct position. This removes the Model T-120 from the input.

OPERATION:

1. Connect input to "In" and "COM" terminals (see specifications for max. input voltage).
2. Select desired input:
 - a. +, - (isolated input). Connect low side of output to ground terminal lug.
 - b. DIRECT- Connect low side of input to ground terminal lug.
3. Read output from "OUT" and "COM" terminals.
4. In "DIRECT" position both "COM" terminals are connected by large, low resistance wire to guarantee minimum degradation of accuracy due to line loss.

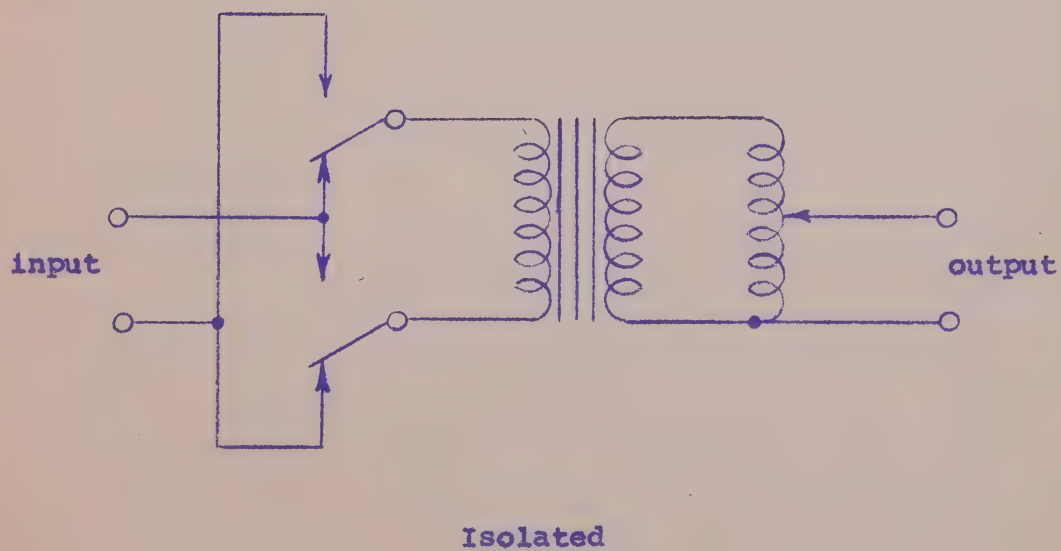
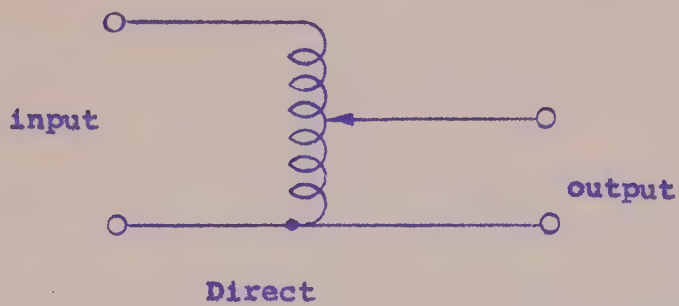


Fig. 2 Schematic RB-503T, RB-504T
6.



APPLICATIONS:

The RB-503T and RB-504T Ratio Boxes are ideal for the precision calibration of resolvers and synchros where minimum loading, high accuracy, and low phase shift are essential. They also eliminate the need for re-arranging the test setup or providing additional inversion switching within the test set. In these and other applications, use of the ratio boxes in conjunction with North Atlantic's Phase Angle Voltmeter* permits rapid, direct reading of nulls, phase shift angle, and quadrature voltage.

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SUMMING NETWORK TECHNIQUE

In Figure 3 the output of the test piece is arranged to have a polarity opposite to that of the ratio device. By means of precision summing resistors--available from NORTH ATLANTIC as the P202 PLUG-IN SUMMARY MODULES, the outputs are added. At null the ratio device will then read the in-phase ratio of the item under test. In this particular test set up a line isolation transformer is utilized so as to avoid grounding one side of the line. For illustrative purposes the NORTH ATLANTIC P-201 PLUG-IN REFERENCE ISOLATION MODULE is also shown as providing circuit isolation on the reference input. This feature can also be built into the voltmeter.

In using the circuit of Figure 3, care should be exercised in evaluating the errors which can arise due to loading of the test piece by the summing resistors and inaccurate summing due to test piece source impedance.

Phase angle is easily measured using the technique shown in the following section for small angle measurement. Allowance must be made in this case for the 2:1 change in voltmeter sensitivity resulting from the summing network.

II. BRIDGING TRANSFORMER TECHNIQUE

For greater accuracy, the circuit of Figure 4 has found wide acceptance where the requisite polarity arrangement is feasible. In this case, matching of the test piece output to the ratio device is achieved by using a bridging transformer. A NORTH ATLANTIC P203 BRIDGING TRANSFORMER MODULE is shown, although any good double-shielded isolation transformer with suitable common mode rejection and low input capacitance would suffice.

Measurement errors in Figure 4 can occur due to capacitive loading of the test piece or capacitive coupling of the common mode signal into the secondary. The former can be minimized where shielded cables are used by using the so called "driven shield" technique shown in the figure.



Common mode rejection is a function of the transformer shielding, the impedance level of each input to the transformer and the relative values of these impedances. Each set up must be judged by itself as to its suitability for a particular measurement.

Phase angle again is easily measured using the small angle measuring technique shown in the following section. Here allowance must be made for the bridging transformer transformation ratio (1:1 for the NORTH ATLANTIC P203 MODULE).

Both of the above measuring systems are used to provide a direct reading of in-phase ratio. Transformation ratio is by definition the ratio of the absolute magnitude of the secondary to primary voltage. To obtain "transformation ratio" the "in-phase" ratio must be divided by the cosine of the phase shift angle.

Maximum accuracies for both set-ups require that the phase dial be adjusted to compensate for residual phase shifts arising from the various transformers in the system, etc. This is conveniently done by stepping the ratio device and adjusting the phase dial to produce zero output when the function selector is in the 90° position. Operation will then be correct when the function selector is returned to the 0° position.



TRANSFORMATION RATIO MEASUREMENTS

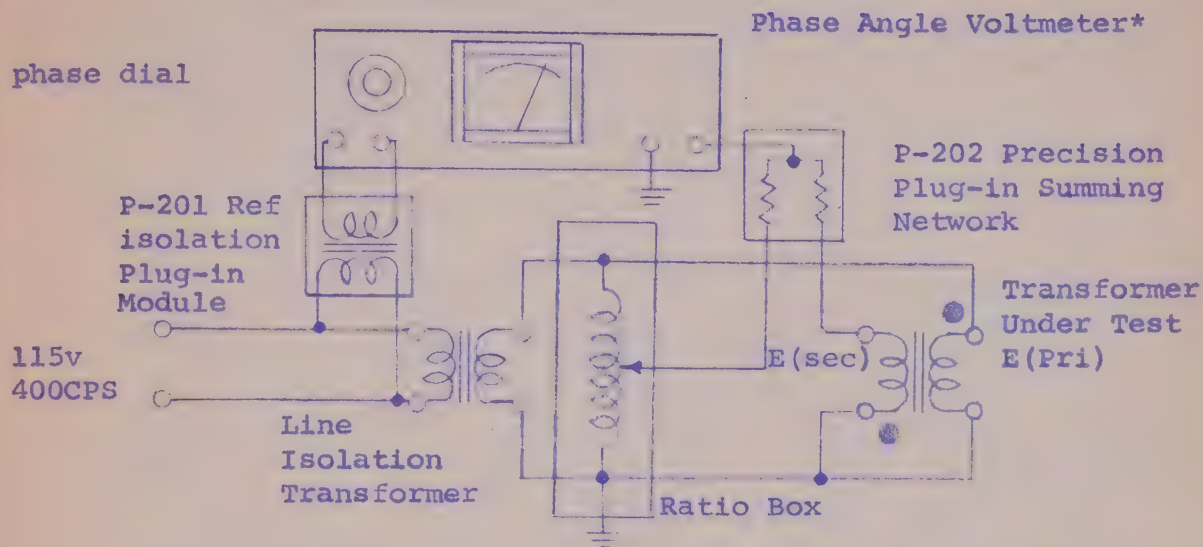


Fig. 3 Parallel Summing

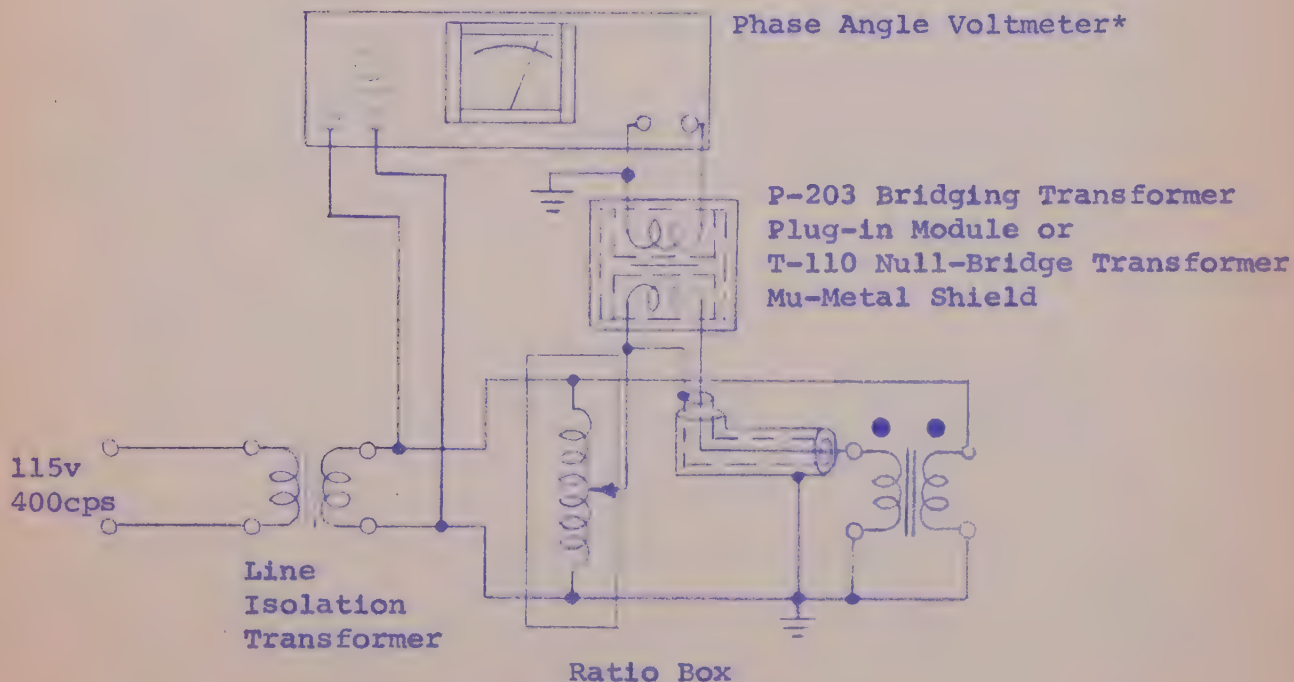


Fig. 4 Series Summing

PRECISION RATIO METER



In many analogue computer systems the process of multiplication, division, addition, and subtraction is accomplished using precision potentiometers, or resistors. Those applications involving extremes of precision must be concerned with the distributed capacitance of the circuit element. Ordinary nulling system, for example, will not permit the manufacture of very precise resistors because of the errors masked by quadrature signals. The circuit of Figure 5 permits precise zeroing of pots or matching and calibration of resistors and potentiometers independent of stray capacitances, or harmonics in the signal source

*Phase Angle Voltmeter

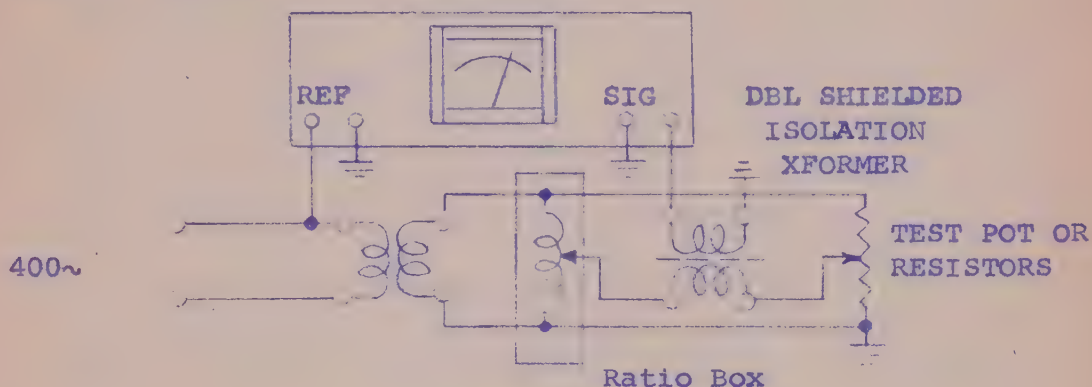


Fig. 5

Two isolation transformers are actually not necessary. If the source is to be isolated then an inexpensive transformer can be used. If the outputs are to be isolated then a low capacitance transformer such as a North Atlantic T-110 should be used. An alternate arrangement would be the circuit of Figure 6, which uses a summing network.

Phase Angle Voltmeter*

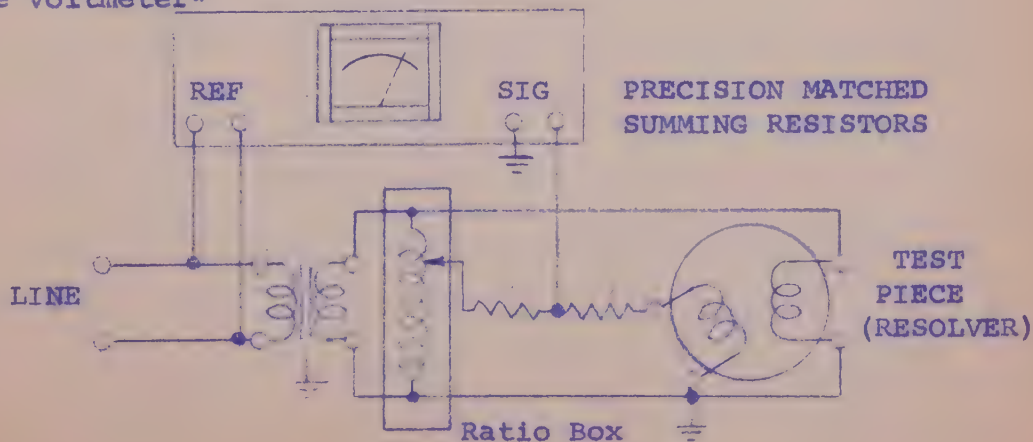


Fig. 6
10.

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REPLACEMENT PARTS LIST

<u>NAI Part No.</u>	<u>Description</u>	<u>RB-503T</u>	<u>RB-504T</u>
D-500063	Switch, 1st Decade		1
C-500064	Switch, 2nd and 3rd Decades		2
C-500065	Switch, 4th and 5th Decades		2
C-500066	Switch, 4th and 5th Decades	2	
C-500067	Switch, 1st Decade	1	
C-500068	Switch, 2nd and 3rd Decades	2	
B-500023-1	Dial, Assembly, 0 thru 10, graduated	1	1
B-500023-1	Dial, Assembly, 0 thru 10, ungraduated	5	4
B-500023-3	Dial, Assembly, (Red) thru 10		1
C-200380	Window	1	1
B-800568	Rheostat (last digit)		1
B-802616	Rheostat (last digit)	1	
	Fuse (output) 1 amp. Littelfuse #312005 or equal	1	1
C-200215	Ratio Transformer, 1st Decade		1
C-200214	Ratio Transformer, 2nd Decade		1
C-200208	Ratio Transformer, 3rd Decade		1
C-200210	Ratio Transformer, 4th Decade		1
C-200211	Ratio Transformer, 5th Decade		1



<u>NAI Part No.</u>	<u>Description</u>	<u>RB-503T</u>	<u>RB-504T</u>
C-201792	Ratio Transformer, 2nd & 3rd Decades	1	
C-201793	Ratio Transformer, 4th & 5th Decades	1	
800941	Knob, GEE-LAR #J-385 or equal	6	6
801877	Switch, Polarity	1	1
405051	Precision Inversion Transformer T-120	1	1



CAUTION

High voltage exists at several points in the instrument. Normal precautions consistent with good practice should be taken to reduce shock hazard.

A potential shock hazard exists when ungrounded power source or ungrounded case operation is employed. Persons operating the instrument should be made aware of and take precautions against this condition.

North Atlantic Industries, Inc. cannot be held responsible for damage to person or property in the process of or as a result of maintenance, calibration or setting up of instrument.



WARRANTY

North Atlantic Industries, Inc. hereby warrants that this instrument is free from defects in material and workmanship. Liability under this warranty is limited to servicing, calibrating and replacing any defective parts with the exception of electron tubes and fuses if, within one (1) year after shipment the original purchaser notifies North Atlantic Industries, Inc. that the instrument is defective. Notification to the Sales Order Department of North Atlantic Industries, Inc. should give full details of the defect, including model and serial number of the instrument. Purchaser shall then await servicing or shipping instructions from North Atlantic Industries, Inc.

North Atlantic Industries, Inc. will repair and pay transportation charges of any instrument that is found defective during the period of our warranty. This shall be subject to the condition that there is no evidence that the instrument has been operated beyond its design range, has been improperly tested, or has been opened, disassembled, modified, dropped or tampered with in any way.

In the event that repairs are necessary which are not covered by the warranty, an estimate of costs to be incurred will be submitted for written approval before any work other than determining the defect is undertaken.

In-warranty repairs will be returned, transportation paid, by the original methods of shipment. Repairs not covered by the warranty will be returned in accordance with purchaser's instructions submitted with approval of repair charges.

North Atlantic Industries, Inc. shall not be liable for damage or injury to persons or property resulting from the operation of the instrument.

NOTE

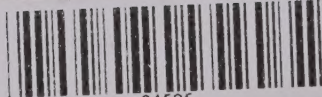
This instrument has been carefully checked and packaged prior to shipment. Any loss, damage, or delay in shipment should be reported to the carrier. Further, if upon receipt the instrument fails to operate properly, or is damaged in any way, a claim should be filed with the carrier claim agent and forwarded to North Atlantic Industries, Inc., who will advise disposition and arrange for repair or replacement of the instrument.

In line with North Atlantic Industries' policy of prompt service to all customers, every effort will be made to repair and return any instrument as rapidly as possible.

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